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(54) TIME DIVISION MULTIPLEX COMMUNICATION METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To properly decide a slot number for improving communication efficiency in the time division multiplex communication, where a plurality of slots are provided to each frame.

SOLUTION: In a step 2, the number of slots is increased upon the receipt of a communication request from an on-vehicle station and in a step 10, the number of the slots is decreased when communications with a vehicle are completed.

CLAIMS

[Claim(s)]
[Claim 1]One specific office is the time-division multiplex communication method which communicates among two or more distant offices, Have the large unit time containing small unit time of a predetermined number, assign small unit time to each distant office according to predetermined turn for each large unit time of every, and at assigned small unit time. A time-division multiplex communication method making variable a predetermined number of said small unit time contained in said large unit time in a correspondence procedure which communicates between distant offices to which the unit time concerned was assigned.
[Claim 2]A time-division multiplex communication method which is the correspondence procedure according to claim 1, and is characterized by coinciding a predetermined number of said small unit time with the number of said specific office and said distant offices which can be communicated.
[Claim 3]A time-division multiplex communication method that it is the correspondence procedure according to claim 2, and said distant office is characterized by a movable thing.
[Claim 4]A time-division multiplex communication method which is the correspondence procedure according to claim 3, and is characterized by attaining said specific office and communication of the near distant office concerned when said distant office approaches said specific office.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]A time divisional multi-communication system, i.e., hour corresponding, is divided into the short unit time called a time slot, and it is related with the communication method used for communication with the distant office which is different in each unit time.

[0002]

[Description of the Prior Art]When one office communicates with two or more distant offices conventionally using a time divisional multi-communication system, the time basis called a time slot is set up and the method which assigns this time slot to each distant office is used. Namely, if it uses only for communication between one offices in two or more distant offices, the time passes and the time corresponding to the following time slot comes, the time corresponding to one time slot, It is the method of using only for communication between another distant offices which were able to assign the following time slot concerned. Thus, whenever a time slot changes, the method of communicating between another distant offices one after another is used.

[0003]Here, the time slot of the predetermined number is summarized in the form where two or more time slots are provided into the big unit time called a frame. It is decided in the turn of the

time slot in this frame that the distant office of an assignment place will be a meaning. Namely, in a certain frame, make into the first distant office the distant office to which the first time slot was assigned, and the second time slot the assigned distant office as the second distant office, If the distant office to which the n-th time slot was assigned below is made into the n-th distant office, also in another frame, will assign the first time slot to the first distant office, the second time slot will be assigned to the second distant office, and the n-th time slot will be assigned to the n-th distant office one by one below. This relation is common in all the frames.

[0004]If it comes to time to communicate between the distant offices which were able to assign the time slot, for time pass, and only for time to correspond to this time slot correspond to another time slot, Communication with the distant office which was communicating till then is closed, and communication with another distant office to which the another time slot concerned was assigned is started. Thus, by performing communication with a different distant office one after another, and repeating this operation periodically for every frame, it operates as if it performed communication with two or more distant offices in parallel.

[0005]It depended for the number of the time slots in a frame on the application software of communications control at this time. Namely, application software was communicating by declaring beforehand the number of the time slots contained in one frame, and creating a time slot just like that. The number of these time slots was being fixed.

[0006]

[Problem(s) to be Solved by the Invention]It is used for the communication system between road and car of such communication technology and ITS (advanced road information system). In ITS, it communicates between the road-side office established in the road side, and the mounted office carried in the vehicles which run the road near a road-side office, a time slot is assigned for each mounted office of every, and what is called communication between highway and vehicle is performed.

[0007]At this time, the whole of the first time slot in each frame to the mounted office of the first vehicles. the second time slot -- all -- the mounted office of the second vehicles -- the following -- the n-th time slot -- all -- the mounted office of the n-th vehicles -- one time slot is assigned from the inside of each frame to the mounted office carried in each vehicles so that it may say. Thus, all the mounted offices can be assigned in all the frames, and only the time for a ****** time slot can communicate between road-side offices.

[0008]Here, in a specific frame, the number of the mounted offices which should communicate with a road-side office is changed according to the situation of traffic. That is, according to how many vehicles which carry a mounted office in the communication available area which can

communicate between road-side offices advance into within a time [corresponding to a specific frame], the number of the mounted offices which should communicate with a road-side office is changed. According to this, the number of the time slots which should be provided in one frame is also changed. This is for the number of the time slots provided in one frame to specify the maximum of the number of mounted offices which can communicate between road-side offices in the frame concerned.

[0009]To such a problem, supposing the maximum number which can be considered as the number of distant offices, it is possible to define the number of time slots per one frame so that it may not be less than the number at least. For example, in an above-mentioned communication system between road and car, the case where the road was congested and the distance between two cars is narrow is assumed. Or the situation of traffic congestion is assumed. By the ability to advance how many [a maximum of] vehicles into the communication available area which one road-side office covers as a field in which communication with a road-side office and vehicles is possible in this situation, since this is a simple problem like the number of accommodation in the motor pool of the flat ground, What is necessary is to guess the maximum number of a distant office based on the number which can be advanced, and just to define the number of time slots per one frame so that it may not be less than it. If it is made such, the problem that it cannot communicate with some mounted offices is avoidable at least.

[0010]On the other hand, because this cannot say the best technique seen from the field of communication efficiency, assignment of the time slot in one frame is one time slot to one mounted office, and it is because the time slot which was not assigned becomes useless substantially. Because only the part of a useless time slot consumes time, without communicating, since it becomes, the futility of the time similar to waiting time will be produced during communication.

[0011]Especially the thing for which the futility of such time is excluded and communication efficiency is raised to the maximum extent is a very important technical problem, when communicating between the mounted office and road-side office which were carried in the vehicles under run at high speed. In this system, it is because it is required it to be required for that the communication available area which is a field which can communicate by one side should be narrowed, and confusion of two or more vehicles should be avoided, it to extend communication available area on the other hand, and to enable redundant communication etc.

[0012]In order to fill this contrary demand, even if raise above-mentioned communication efficiency, time until it completes general communication is shortened, communication available area is narrowed and it shortens communication available time, it is very effective to enable it to

fully complete communication. If communication available area is narrowed on it and it enables it to avoid confusion of two or more vehicles, the above-mentioned demand can be met. Thus, the futility of a time slot is excluded in time-division multiplex communication, and it has been a very important technical problem to raise communication efficiency.

[0013]

[Means for Solving the Problem]It is the purpose of solving this above-mentioned technical problem, and the number of time slots in one frame is made variable in a communication system between road and car in this invention.

[0014]

[Embodiment of the Invention]Hereafter, an example is given and explained about the suitable embodiment of this invention. The system outline view which illustrates the embodiment of this invention is shown in drawing 1. In a figure, 1 is a road and the road-side office (transmitter) where 2 was provided in the suitable place on the road 1, and 3 are the vehicles which carry the mounted office (transmitter) which is not illustrated. In this composition, the vehicles 3 run the road 1 top, as shown in a figure. At this time, after the vehicles 3 have approached the road-side office 2, even if the vehicles 3 are running, communication has become possible between the road-side office 2 and the mounted office carried in the vehicles 3.

[0015]It becomes a place which agrees for the purpose of managing passage of vehicles on the road 1, as a suitable place in which the road-side office 2 is installed. For example, it is the place that the manned tollgate is installed on the conventional highway.

[0016]The protocol used for the communication performed to drawing 2 between the above-mentioned road-side office 2 and a mounted office is shown. A series of sequences from FCM to END shown in a figure show the signal group of predetermined length used for communication. This whole signal group is called a frame. This frame is constituted by transmitting continuously each signal sequence to FCM, MDS, or END divided into the figure by the frame of the rectangular head. each signal sequence of this -- respectively -- a time slot -- or it is only called a slot. Here, a time slot is only called a slot for short below.

[0017]In this sequence, the time when the right direction is late is shown for the time when a left is early, respectively. Therefore, it begins from FCM first, next is transmitted to MDS, and 1, 2 and turn, finally END is transmitted, and a signal ends transmission for one frame. The special signal which shows the number of slots and the use of a slot in the frame concerned is stored in the slot of FCM here, and the slot of this FCM is certainly transmitted to the beginning of the frame concerned.

[0018]Here, the information transmitted between the road-side office 2 and a mounted office is

put on middle 1 thru/or 8. Namely, 5 thru/or 8 1 thru/or 4 shown as UPLINK in the figure was indicated to be to the transmission to the road-side office 2 from vehicles as DOWNLINK in the figure is assigned to the transmission on vehicles from the road-side office 2, respectively.

[0019]Drawing 3 is a figure showing typically the state of actually communicating based on the above-mentioned protocol. Actual communication is performed with the gestalt that a mounted office transmits needed information to the road-side office 2 first, and the road-side office 2 which received this needed information transmits a signal to a clinch mount office.

[0020]First, a mounted office transmits needed information. Although carried out by putting this needed information on UPLINK, the mounted office itself does not recognize whether which slot is vacant, namely, it can use for communication. Then, the mounted office is provided with the pseudorandom number generation function, it generates a pseudo-random number using this function in advance of needed information, based on the random number by which it was generated, chooses a slot, puts it on the selected slot arbitrarily, and transmits needed information. If needed information is received normally as a result and a signal is transmitted from the road-side office 2, a mounted office will continue communication as it is, but if there is no signal from a road-side office, needed information will choose a slot arbitrarily again as those with a possibility of not having arrived at the road-side office 2 normally, and a mounted office will resend needed information.

[0021]For this reason, when two or more mounted offices choose the same slot and transmit needed information simultaneous, for example, this needed information is not correctly recognized in the road-side office 2. At this time, each mounted office generates a random number anew, and rechooses a slot arbitrarily. In this case, since there is nothing actually, it does not repeat the same phenomenon that two or more vehicles choose the same slot again. After this, in the road-side office 2 which received needed information, the received needed information is analyzed and the signal which answers this is generated for every mounted office.

[0022]Subsequently, the signal generated for every mounted office is assigned to the slot of DOWNLINK, and it transmits towards a mounted office for every assigned slot. Thus, communication of a series of frames is completed.

[0023]The time slot assignment which should be performed before and after communication, and the flow chart of elimination are shown in drawing 4. In drawing 4, the existence of the needed information from vehicles is first investigated in Step 1. When there is no needed information, operation of Step 1 is repeated in preparation for the case where needed information is received newly. When needed information occurs, a slot number is added in Step 2.

[0024]The concept of addition of a slot number is shown in drawing 5. In drawing 5, tops are a

frame structure before the processing in Step 2, and a frame structure after processing [in / in the bottom / Step 2]. In the figure, in DOWNLINK, only 1 adds the number of slots, and TS7 is added.

[0025]Next, in Step 3, it is judged whether the slot number reached the maximum. Since a slot number cannot be made to increase by more than it when the maximum number is reached, a judgment at Step 4 described below is omitted, acceptance of the further needed information is closed, and it shifts to Step 6.

[0026]When the maximum number is not reached, in the following step 4, it is judged whether it went through predetermined time. Since it is possible to accept the needed information from another vehicles when not having gone through predetermined time, it returns to Step 1 again. When it goes through predetermined time, in order to have to start communication with the vehicles which already had needed information, irrespective of the existence of a margin which accepts needed information, acceptance of the further needed information is closed and it shifts to Step 6.

[0027]Next, a time slot is assigned to needed information in Step 6. Although many things are considered by how to assign a slot at this time, it may be made to assign a slot to the early order of needed information, for example. namely, the needed information which received the slot 1 next to the needed information received first -- the slot 2 -- it may be made to assign a slot one by one so that it may say

[0028]Furthermore in Step 7, the quota data for FCM is generated. The information how many slots are included in one frame and whether each slot is assigned to which needed information, i.e., which mounted office, is included in the quota data for this FCM. In the mounted office which received the signal from the road-side office 2, this quota data is read and it can be judged whether the data of which slot is required because of self-vehicles. As a result, about the slot judged to be data for the other car, you may ignore by the mounted office side.

[0029]This quota data is reflecting the result of having added the slot number in Step 2. That is, when the slot number is changed in processing of Step 2, the changed slot number is shown.

[0030]Next, actual communication is performed in Step 8. As opposed to a number of slots which communication here was one-way communication to a mounted office from the road-side office 2, and omitted addition or processing of Step 2 and were not added in Step 2, The respectively individual mounted office is assigned and actual communication is performed between the road-side office 2 and each mounted office based on this assignment.

[0031]Then, in Step 9, it is judged whether all communications were completed between specific mounted offices. Since it is not necessary to communicate between the mounted offices concerned

with the following frame and a signal will not be transmitted towards the mounted office concerned if it has completed, in Step 10, only 1 subtracts a slot number. When not having completed, a slot number is not subtracted as skipping Step 10.

[0032]The concept of subtraction of a slot number is shown in drawing 6. In drawing 6, tops are a frame structure before the processing in Step 10, and a frame structure after processing [in / in the bottom / Step 10]. In the figure, in DOWNLINK, only 1 subtracts the number of slots, and the slot 7 is deleted.

[0033]Next, in Step 11, it is judged whether it went judgment of Step 9 to all the mounted offices which were able to assign the present slot. When the mounted office which has not been judged yet remains, processing after Step 9 is similarly performed about the mounted office which has not been judged. When judgment is finished about all the mounted offices, a series of processings are ended.

[0034]

[Effect of the Invention]Since the number of slots was made variable in this invention according to the needed information from a mounted office as explained above, The number of frames will fluctuate suitably according to the number of the needed information from a mounted office, can use a slot effectively as the result, and can shorten the time length of a frame as much as possible. For this reason, efficient communication can be performed in time.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]It is an outline view showing the outline of the communication system between road and car which can apply this invention.

[Drawing 2]It is an explanatory view showing the concept of the protocol of time-division multiplex communication.

[Drawing 3]It is an explanatory view showing a communicating state.

[Drawing 4]It is an explanatory view showing the procedure of communications processing.

[Drawing 5]It is an explanatory view showing the concept of addition of a slot number.

[Drawing 6]It is an explanatory view showing the concept of subtraction of a slot number.

[Description of Notations]

1 Road

2 Road-side office